# REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN PART II--QUALITY ASSURANCE PROJECT PLAN FOR THE TEST AREA NORTH GROUNDWATER OPERABLE UNIT AT THE IDAHO NATIONAL ENGINEERING LABORATORY

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# ACRONYMS

| | |
|---|---|
| ARDC | Administrative Records and Document Control |
| ASTM | American Society for Testing and Materials |
| CCS | calibration control standard |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CLP | Contract Laboratory Program (EPA's) |
| COC | chain of custody |
| COCA | Compliance Order and Consent Agreement |
| CRDL | contract-required detection limit |
| CVAA | cold vapor atomic adsorption |
| DMP | Data Management Plan |
| DOE | Department of Energy |
| DOE-ID | Department of Energy, Idaho Field Office |
| DOT | Department of Transportation |
| DQO | data quality objective |
| EIRC | ERD Independent Review Committee |
| EPA | Environmental Protection Agency |
| ERD | Environmental Restoration Department |
| FAA | flame atomic adsorption |
| FFA/CO | Federal Facility Agreement/Consent Order |
| FS | feasibility study |
| FSP | Field Sampling Plan |
| FTL | Field Team Leader |

| | |
|---|---|
| GFAA | graphite furnace atomic adsorption |
| HRS | hazard ranking system |
| HSP | Health and Safety Plan |
| HYAA | hydride atomic adsorption |
| ICP | inductively coupled plasma |
| IDL | instrument detection limit |
| IH | Industrial Hygienist |
| INEL | Idaho National Engineering Laboratory |
| LCS | laboratory control standard |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| NBS | National Bureau of Standards |
| NCP | National Contingency Plan |
| NEIC | National Enforcement Investigation Center |
| NIST | National Institute of Standards and Technology |
| NPL | National Priorities List |
| OSWER | Office of Solid Waste and Emergency Response |
| PARCC | precision, accuracy, representativeness, completeness, and comparability |
| ppm | parts per million |
| QA | quality assurance |
| QA/QC | quality assurance/quality control |
| QAPjP | Quality Assurance Project Plan |
| QC | quality control |
| RAS | routine analytical service |
| RCRA | Resource Conservation and Recovery Act |
| RI/FS | remedial investigation/feasibility study |

| | |
|---|---|
| RI | remedial investigation |
| RPD | relative percent difference |
| SAP | Sampling and Analysis Plan |
| SARA | Superfund Amendments and Reauthorization Act |
| SAS | special analytical service |
| SDG | Sample Delivery Group |
| SOP | standard operating procedure |
| SOW | Statement of Work |
| TAN | Test Area North |
| TSF | Technical Support Facility |
| USGS | United States Geological Survey |
| VOA | volatile organic analysis |
| WAG | waste area group |

# 3. PROJECT DESCRIPTION

## 3.1 INTRODUCTION

This document presents the Quality Assurance Project Plan (QAPjP) for the remedial investigation of Test Area North (TAN) groundwater at the Idaho National Engineering Laboratory (INEL) near Idaho Falls, Idaho. The QAPjP is written documentation of procedures that ensure precision, accuracy, representativeness, completeness, and comparability (PARCC) of data generated during an investigation. The QAPjP was prepared using the Environmental Protection Agency's (EPA's) guidelines, including "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (EPA, 1980) and the Quality Program Plan for the Environmental Restoration Program (ERP) (EG&G Idaho, 1990). The QAPjP also addresses requirements set forth in 40 CFR 30, including procedures to ensure the PARCC of groundwater and field chemistry data collected during field investigations. The QAPjP is used by field, laboratory, and management personnel in all aspects of data collection, management, and control while on or offsite.

This QAPjP accompanies a set of other documents that constitutes background and guidance for performing the investigation. Specific issues that control data quality are found in a number of documents. Data quality objectives, sample location and frequency, and numbers of samples are described in the Field Sampling Plan (FSP). Quality control (QC) samples generation, chain of custody (COC), preservation and shipping, instrument calibration, quality assurance (QA) objectives, internal QC checks, audits, preventive maintenance, measurement of PARCC, corrective actions, and QA reporting are presented in this QAPjP.

Analytical procedures are presented in the FSP. Data reduction and reporting are described in the Data Management Plan (DMP). Data validation is discussed in Section 10 of this QAPjP.

The purpose of the Sampling and Analysis Plan is to guide the collection and analysis of samples for a remedial investigation (RI) of the TAN

Groundwater RI/FS. This route of investigation has been chosen to facilitate data development in this RI/FS as a result of a Federal Facility Agreement/ Consent Order (FFA/CO) between DOE, EPA, and the State of Idaho. This FFA/CO guides the overall CERCLA response at the INEL.

The Sampling and Analysis Plan consists of three parts: the FSP, the QAPjP, and the DMP. These plans have been prepared pursuant to the NCP (EPA, 1990) and guidance from the EPA on the preparation of sampling and analysis plans.

The FSP describes the field activities that will occur as part of the RI; the QAPjP describes the processes and programs that will be used to ensure the data generated will be suitable for its intended use; and the DMP describes the flow of data from generation to use. Background information on TAN and the groundwater RI/FS is found in Section 2 of the Work Plan and the FSP.

## 3.2 TAN Operable Unit Regulatory History

Information on the regulatory history for the FFA/CO groundwater operable unit at TAN is contained in the FSP and Section 1.2 of the Work Plan.

## 3.3 Site Description

The history of TAN operations that have an impact on the TAN Groundwater RI/FS are discussed in detail in Sections 2.2 and 2.3 of the RI/FS Work Plan. The reader is referred to these sections for information on waste generation, processes, and disposal.

## 3.4 Project Location

The TAN Groundwater operable unit at the INEL is located approximately 50 mi northwest of Idaho Falls, Idaho, and is the northern-most facility within the INEL. Additional information on TAN facilities is given in the FSP and in Section 2 of the RI/FS Work Plan.

## 3.5 SCHEDULE

A detailed schedule of RI/FS activities for the TAN Groundwater RI/FS as proposed in the RI/FS Work Plan can be found in Section 6 of the Work Plan. RI/FS activities essentially started in July 1991 with development of the Scope of Work for the TAN Groundwater RI/FS, and will continue until approval of the Record of Decision, proposed for September 1994.

## 3.6 DATA USE

The intended end uses of data gathered as part of the RI/FS are to aid in the understanding of the hydrogeologic system at TAN, determine the overall nature and extent of contamination, and ultimately to aid in the selection of an appropriate remedial alternative for the site. Information needed to fill data gaps for the RI/FS has been identified in Section 4 of the Work Plan. Tasks planned to provide necessary data have been generally discussed in Section 5 of the Work Plan and are detailed in the FSP.

# 4. PROJECT ORGANIZATION AND RESPONSIBILITY

## 4.1 OWNERSHIP

The INEL is managed by the U.S. Department of Energy, Idaho Field Office (DOE-ID). EG&G Idaho, Inc., is the site contractor responsible for operations where the sampling unit is located. DOE-ID has primary responsibility and authority for RCRA/CERCLA EPA Regulatory Compliance activities at TAN.

## 4.2 ORGANIZATION OF PROJECT PERSONNEL

Figure 4-1 shows the project organizational structure and key personnel for the TAN Groundwater Project.

### Environmental Restoration Department Manager

The Environmental Restoration Department (ERD) Manager is responsible for incorporating and implementing the Environmental Restoration Quality Program with this QAPjP and QPP-149. The ERD Manager provides technical coordination and interface with the DOE-ID Technical Program Manager. The ERD Manager ensures that all activities are conducted in accordance with program requirements; monitors the project budget and schedule; and ensures the availability of necessary personnel, equipment, subcontractors, and service.

### Site Remediation Group Manager

The Site Remediation Group Manager is responsible for Waste Area Groups (WAGs) 1, 2, 4, 5, 6, 10, and the Decontamination and Decommissioning Unit. Work includes management and coordination of both FFA/CO and non-FFA/CO projects.

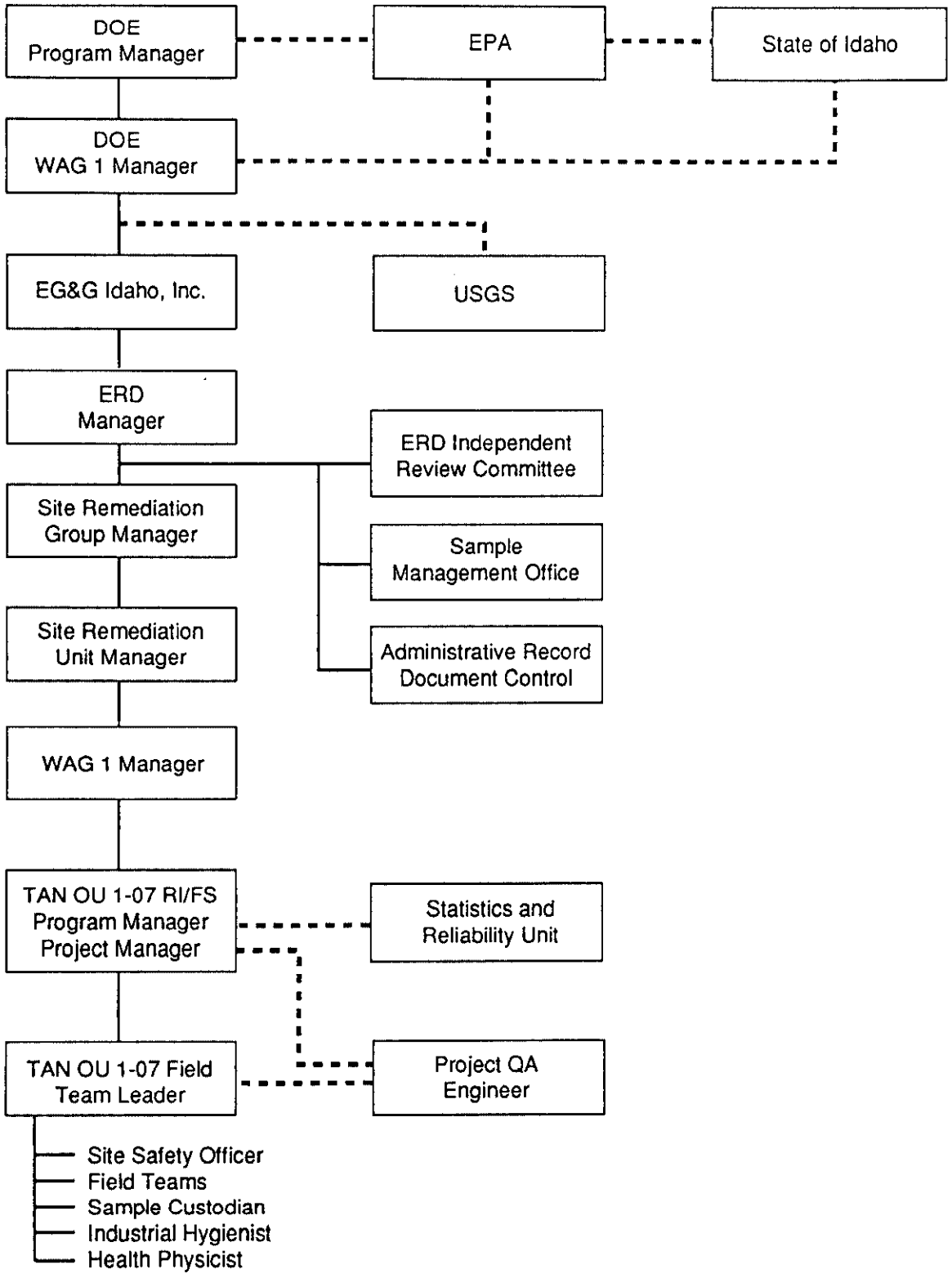


**Figure 4-1.** TAN groundwater remedial investigation project organization.

**Site Remediation Unit Manager**

The manager of the Site Remediation Unit is responsible for WAGs #1, 4, 5, 6, and 10, and management and coordination of the operable units associated with these WAGs under the FFA/CO.

**ERD Independent Review Committee**

The ERD Independent Review Committee (EIRC) will review initial planning documents, such as sampling and analysis plans (SAPs), standard operating procedures (SOPs), and detailed operating procedures to ensure that the plans will produce data of the required level. At the time the finished data are submitted for verification, the EIRC will inspect sample custody documentation, QA/QC procedures, and procedures used to assign uncertainties.

**Waste Area Group 1 Manager**

The WAG 1 Manager oversees several projects and coordinates progress within the jurisdiction in which those projects are being investigated, including the TAN groundwater project.

**Program and Project Managers**

The Program Manager is responsible for the senior technical review of all project plans and deliverables. The Project Manager is responsible for ensuring that drilling and sampling activities are completed in accordance with the QAPjP, the QPP-149 document, the Health and Safety Plan (HSP), and the Field Sampling Plan (FSP). In addition, the individual will keep the WAG Manager informed of project status and any technical, administrative, contractual, and financial issues with the proposed resolutions.

**Quality Assurance/QA Engineer**

The Project QA Engineer reports to the Project Manager and is responsible to see that project quality assurance requirements are met and that the QAPjP is implemented.

**Field Team Leader**

The Field Team Leader (FTL) will oversee field operations and will report to the Project Manager. The FTL is responsible for implementing the FSP, the QAPjP, and the DMP for field activities (such as sampling).

The FTL has the primary responsibility for ensuring the fulfillment of technical and operational requirements of the sampling plan. The FTL is also responsible to do the following:

- Locate support facilities outside of the areas where potentially contaminated samples are to be collected
- Integrate contact with facility safety and operations personnel and ensure that field team personnel are familiar with the location of the facility dispensary
- Instruct team personnel at a pretask briefing on technical, operational, quality, and safety requirements of the task
- Observe all site activities and ensure that the team meets all safety, quality, and operational requirements outlined in this document, in other sampling plans, and the HSP
- Ensure that all safety equipment is available and in good working order before any potentially hazardous operation is initiated
- Control access to and departure from the working site
- Ensure compliance with field documentation, sampling methods, and COC requirements
- Determine, in conjunction with the Site Safety Officer, the level of personal protection necessary for the task being performed
- Enforce the buddy system.

**Field Team Members**

Field Team Members perform the actual field data gathering in accordance with approved plans and procedures under the direction of the FTL.

**Site Safety Officer**

The Site Safety Officer is responsible for health and safety inspections of the work site. This role is usually filled by the FTL or the Industrial Hygienist.

**Sample Custodian**

The Sample Custodian is responsible for documenting, handling, packaging, preserving, and shipping samples. This individual will document all sample descriptions and activity in a field logbook and fulfill COC procedures as described in the QAPjP.

**Health Physics Technician**

The Health Physics Technician will be the primary source of information and guidance for monitoring radiological hazards and will be on call and accessible by radio during sampling activities.

**Industrial Hygienist**

The Industrial Hygienist (IH) will be responsible for the adherence to all site safety requirements by the team members. The IH will assist in conducting briefings and in performing the final safety check of the area prior to each sampling event.

**Sample Management Office**

The Sample Management Office (SMO) conducts data validation. Its responsibilities are described in the Data Management Plan and in QPP-149. Data entry and manipulation are performed by the Statistic and Reliability Unit. Its responsibilities are in the Data Management Plan and in QPP-149.

**Administrative Record and Document Control Coordinator**

The Administrative Record and Document Control (ARDC) Coordinator for ERD will maintain a supply of all controlled documents and have a documented filing system for the storage of all documents (e.g., reports, correspondence); all field laboratory data (e.g., field notebooks and raw data), including laboratory CLP data packages; and all references and final reports from the TAN Groundwater RI/FS.

**Statistics and Reliability Unit**

The Statistics and Reliability Unit assists the Project Manager and the Sample Management Office in analyzing field data for statistical values (means, standard deviations) and in analyzing trends in the data.

# 5. QA OBJECTIVES FOR MEASUREMENT DATA

The objective of this QAPjP is to ensure that the information collected for decision making during the TAN Groundwater RI/FS is of known and adequate quality, and is technically sound, statistically accurate, and properly documented. By meeting this objective, these data will have the necessary quality for use in making the best possible decisions for the RI/FS. These data quality elements are essential for enforcement proceedings that may arise from RI/FS activities. QA is a management system for ensuring that all information, data, and decisions are technically sound and properly documented. QC is the mechanism by which the QA system is ensured. This usually consists of tests performed on the system for which quality is being ensured, using standards or known quantities. Specific QC procedures related to activities such as sampling, analysis, and engineering calculations will ensure that data are appropriate for risk assessment and enforcement use.

Data quality objectives (DQOs) are described in Section 2 of the FSP. Resulting QA objectives for analytical data (PARCC parameters) are defined in Table 5-1 and Sections 5.1 through 5.5 of this QAPjP.

## 5.1 PRECISION

Control limits for precision at the TAN groundwater investigation sites are generated from Methods for the Chemical Analysis of Water and Wastes (EPA, 1979), Test Methods for Evaluating Solid Waste Physical/Chemical Methods (EPA, 1986a), Methods for the Determination of Organic Compounds in Drinking Water (EPA, 1988a) and the Contract Laboratory Program Statement of Work for Inorganic Analysis (EPA, 1988b or 1990).

A laboratory precision statement will be developed from laboratory duplicate analysis (split samples, split extractants/digestants, duplicate analyses, etc.). Since several types of duplicates can be performed by the laboratory and it is not appropriate to combine them, the following priority

Table 5-1. Analytical precision and accuracy.

| Parameter | Method | Soil | |
|---|---|---|---|
| | | Precision | Accuracy |
| Bulk Density | ASTM D4531 | NA | NA |
| Particle Size | ASTM D422-63 | NA | NA |
| Porosity | ASTM D4531 | NA | NA |
| Hydraulic conductivity | ASTM D2434 | NA | NA |

| | Method | Water | |
|---|---|---|---|
| | | Precision[a] | Accuracy[b] |
| Volatiles | | | |
| 1,1-Dichloroethene | EPA 524.2 and SW-846-8010 | ±22% | 61-145% |
| Trichloroethene | EPA 524.2 and SW-846-8010 | ±24% | 71-120% |
| Benzene | EPA 524.2 and SW-846-8010 | ±21% | 75-130% |
| Toluene | EPA 524.2 and SW-846-8010 | ±21% | 76-125% |
| Chlorobenzene | EPA 524.2 and SW-846-8010 | ±21% | 76-127% |
| Inorganics | CLP SOW | ±20% | 75-125% |
| Radionuclides | RML-6 (11/89) | NA | NA |
| | DM-11 (9/89) | NA | NA |

a. Precision is measured with relative percent difference (RPD) of matrix spike/matrix spike duplicate (MS/MSD) pair analysis for organic analysis. RPD for inorganic analysis is calculated from sample and duplicate analysis.

b. Accuracy is based on spike recovery.

| | | |
|---|---|---|
| ASTM | - | American Society of Testing Materials |
| CLP SOW | - | Contract Lab Program Statement of Work for Inorganics (EPA, 1988b or 1990) |
| RML-6 | - | RML Liquid Sample Count/Analytical Procedures, November 1989 |
| DM-11 | - | RML Gamma Ray Analysis and Activity Report of Lower Activity Level Water Samples, September 1989 |
| SW-846 | - | Test Methods for Evaluating Solid Waste Physical/Chemical Methods (EPA, 1986a) |
| EPA 524.2 | - | Methods for the Determination of Organic Compounds in Drinking Water (EPA, 1988a) |

will be followed for organic and inorganic analyses with respect to which type of laboratory duplicate is used for laboratory precision statements.

Laboratory precision goals for each analytical method are listed in Table 5-1. Precision criteria for method 8010 in the mobile laboratory will be the same as the criteria for the outside laboratory. The overall precision of the sampling and analysis program may be lower due to sampling error and matrix interference.

## 5.2 Accuracy

Accuracy of data obtained is a function of the sampling technique and of the laboratory's analytical capabilities. Control limits for accuracy can be generated from Methods for Chemical Analysis of Water and Wastes (EPA, 1979), Test Methods for Evaluating Solid Waste Physical/Chemical Methods (EPA, 1986a), Methods for the Determination of Organic Compounds in Drinking Water (EPA, 1988a), and the CLP SOW for Inorganics (EPA, 1988b or 1990). Accuracy will be monitored with the use of surrogate recoveries, internal standard recoveries, and blank spike recoveries. Accuracy shall be measured by the percent recovery.

QC samples will be used to assess laboratory accuracy. Laboratory matrix spikes are spikes prepared in the laboratory by splitting a sample and spiking one portion with a known amount of the analyte(s) of interest. The spiked sample result and sample result are compared, and the amount of spike recovered is calculated. The spike recovery is the measure of accuracy.

The accuracy goals presented in Table 5-1 represent analytical accuracy. Accuracy criteria for method 8010 in the mobile laboratory will be the same as for the outside laboratory. The overall accuracy for the project may be less due to contributions of error.

## 5.3 Representativeness

The objective in addressing representativeness is to assess whether or not information obtained during the investigation accurately represents actual site conditions. Representativeness during planning stages of this investigation was addressed in the DQO process described in Section 2 of the FSP and Section 4 of the work plan.

## 5.4 Completeness

Completeness for this project will be assessed by comparing the number of planned sample analyses to the number of samples collected, analyzed, and validated.

The completeness goals for various sampling activities are listed below:

- Sampling and analysis of existing wells - 90%
- Sampling and analysis of aquifer during drilling to determine zone in which to complete new wells (one sample per zone is a critical sample) - 100%
- Sampling and analysis of new RI wells after completion (one sample per well is a critical sample) - 100%.

The objective for completeness is that the investigation provides enough planned data so the objectives of the data collection can be met. If the goal is not met, additional sampling will be necessary.

## 5.5 Comparability

Comparability is used to express the confidence with which one set of data can be compared with another set of data. To assist in comparing data, all analyses will be accomplished utilizing an EPA-accepted method. These methods include the EPA CLP SOW for Inorganics (EPA, 1988b or 1990), methods for the Determination of Organic Compounds in Drinking Water (EPA, 1988a),

published in Test Methods for Evaluating Solid Waste Physical/Chemical Methods (EPA, 1986a), the Index to EPA Test Methods (EPA, 1988c), or those listed in 40 CFR 136 (1984), or approved as an alternative test procedure in accordance with 40 CFR 136. All analytical results will be reported in the concentration values and units required for entry into site-specific data bases and those values and units needed for use in models. In addition, so that data from subsequent sampling at the same site or facility can be compared, the specific sampling points will be established and documented.

Comparability will be assessed by comparing the following information on each data set:

- Field collection methods
- Field and laboratory QA/QC procedures (in accordance with previously established protocols)
- Laboratory detection limits
- Matrix.

# 6. SAMPLING PROCEDURES

The objective of sampling procedures is to obtain samples that represent the environment being investigated. Trace levels of contaminants from external sources must be eliminated through the use of experienced field personnel, good sampling techniques, proper sampling equipment, and adequate decontamination.

Field measurements shall be performed in accordance with EPA-accepted procedures and the procedures listed and described in Appendix B of the FSP.

Details of sampling procedures are described in the FSP, Part I of the three-part SAP. The Field Sampling Methods have been developed, and they are referenced and appended to the FSP (Appendix B).

All samples will be transported to the analytical laboratories in accordance with Department of Transportation (DOT) regulations (49 CFR) governing the shipment of hazardous materials and substances and EPA regulations governing the shipment of samples from hazardous waste site investigations. Originators of hazardous or radioactive shipments must be qualified and certified as Hazardous Material Shippers. Source documents for sample handling may include the User's Guide to the Contract Laboratory Program (EPA, 1986b). Chain of custody and shipping requirements are detailed in ERD Program Directive 5.7, "Chain of Custody Record," and in Section 6.2 of the FSP.

Project Managers or their delegated substitutes (such as field team leaders) are responsible for determining, to the best of their knowledge, whether samples planned for collection are environmental (contain hazardous or dangerous substances) or hazardous (per RCRA subtitle C) in nature. After collection, and (prior to packaging and shipping) each sample will undergo an identification and classification process. A review of the Field Sampling Logbook in which field measurements were recorded (radioactivity, pH, organic vapors, explosivity, etc.) and other relevant information concerning the

material within the sample container will be conducted by the shipper and the Project Manager (or delegated substitute).

Most radioactive samples will meet the definition of limited-quantity radioactive material and are, therefore, exempt from the more stringent DOT requirements for greater activities of radioactive material. All samples will be screened for radioactivity before they are shipped to an analytical laboratory. The screening procedure is described in detail in Section 6.2.3.1 of the FSP and will ensure that the samples are classified correctly and within DOT packaging and shipping requirements. Results from the screening laboratory will then be used to classify, package, and ship the samples to the appropriate analytical laboratory. Requirements for containers, procedures, and preservatives used for sample collection are detailed in Sections 5.3.3 and 6.2 of the FSP. Requirements for field records/documentation are detailed in Section 6.1 of the FSP and in ERD PD 4.2, "Logbooks."

# 7. SAMPLE CUSTODY

## 7.1 Document Control

The procedures that govern document control for this project are ERD Program Directives (PDs) 4.1, "Document Control," 1.8, "Administrative Record," 1.9, "Records Management, and 4.2, "Logbooks." Controlled documents will receive review and concurrence as directed by ERD PD 2.2, "Internal and Independent Review of Documents."

## 7.2 Chain of Custody Documentation

A required part of any sampling and analytical program is the integrity of the sample from collection to data reporting. This includes the ability to trace possession and the handling of samples from the time of collection, through analysis and final disposition. This documentation of the sample's history is referred to as chain of custody (COC). Components of the sampling/field COC, which include a field logbook, sample labels, and custody seals, and of the laboratory COC, which include a COC record, a laboratory sample log-in/log-out logbook, laboratory sample storage records, and laboratory sample disposal records are discussed in the following sections. Sample custody procedures will follow EPA CLP SOW for Inorganics (EPA, 1988b or 1990) and National Enforcement Investigations Center (NEIC) procedures (NEIC, 1980).

A sample is considered to be under a person's custody if it is in that person's physical possession, in view of the person after he has taken possession, or secured by that person so that no one can tamper with it. A person who has samples under custody must comply with the procedures described in the following sections.

## 7.3 Chain of Custody Record

To establish documentation necessary to trace sample possession from the time of collection, a COC record will be completed and accompany every sample. The COC record to be used is exhibited in the TAN FSP and is distributed by ARDC. The record will be completed in ink by the sample custodian and shall contain the following minimum information.

- Sample number (traceable to a sampling location)
- Signature of collector
- Date and time of collection
- Signatures of people involved in the chain of possession
- Inclusive dates and times of possession
- Analyses requested.

To maintain the COC, each person in custody of the sample will sign the form. Samples will not be left unattended unless placed in a secured and sealed container (custody seals) with the COC record inside the container.

## 7.4 Field Logbook

The field logbook is the written record of all field data, observations, field equipment calibrations, and samples, and the COC, and is considered to be a legal document. The logbook will be site specific and bound. The logbook sheets to be used are exhibited in the FSP, and the logbooks will be distributed by ARDC. Pages will be sequentially numbered and firmly attached to the book. All entries will be made in ink. Any mistakes will be lined out with a single line and initialed and dated by the person making the correction. At a minimum, entries in the logbook include the following:

- Reference to the SOP used
- Purpose of sampling
- Location and description of sampling point
- Identification of sampling crew
- Type, number, preservative, and volume of sample
- Date and time of sampling
- Date and time of shipping
- Weather

- Field measurements
- Deviations from SOPs
- COC numbers.

## 7.5 Sample Label

All samples are identified by a sample label. The sample label to be used is exhibited in the FSP. All sample labels shall be filled out using ink. Each sample shall be designated by a unique alphanumeric code that identifies the sample. When samples are transported from the sample location to the contract laboratory by common carrier, they shall be packaged and labeled according to procedures specified by the DOT (49 CFR) and as described in Section 6.2 of the FSP.

As appropriate, information recorded on the sample label shall include the following:

- Unit facility
- Location
- Sample type
- Sample date/time
- Sample number
- Sampling person
- Radiation level (if applicable)
- Analysis requested.

## 7.6 Custody Seals

Custody seals are used to detect unauthorized tampering with samples prior to analysis. Gummed paper seals will be used for this purpose. The custody seal to be used is exhibited in the FSP. The seal is available from the Field Team Leader. The seal will be dated and signed, which makes it unique, and attached so that it must be broken to open the sample container/cooler. If samples are not contained in a shipping container with a custody seal, seals will be affixed to containers before the samples leave the custody of sampling personnel. Shipping containers will also contain seals to detect tampering.

## 7.7 Document Corrections

Documentation in logbooks, custody seals, and other accountable serialized documents will be completed with permanent ink. None of these documents will be destroyed or thrown away, even if they are illegible or if they contain inaccuracies that require they be replaced. They will be marked VOID and maintained in a file. A record of all voided documents will be maintained by ARDC.

If an error is made on an entry into an accountable document, the individual in error will draw a single line through the error, enter the correct information, and initial and date the change. This procedure also applies to words or figures inserted or added to a previously recorded entry.

If a COC record is lost in shipment or was never prepared for a sample, or if a properly labeled sample was not transferred with a formal COC record, a written statement will be prepared by the Field Team Leader detailing how the sample was collected. A copy of the statement will be sent to the project files.

## 7.8 Photographic Records

A photographic record will be made during all field projects. When photographs are taken, the name of the photographer, date, time, sampling site or laboratory location, description of site or activity being photographed, and weather conditions (if appropriate) will be entered in the Field Team Leader's logbook. Special lens, film, filter, or other image-enhancement techniques will be noted in the photographer's logbook. Whenever possible, the use of such techniques will be avoided because they can affect the admissibility of the photographs as evidence. Once developed, slides or photographic prints will be serially numbered (corresponding to logbook descriptions) and labeled. The ARDC Officer will maintain a supply of photograph logbooks and a file of all photographs taken. All photograph logbooks, slides, and prints will be controlled documents.

## 7.9 Laboratory Custody

Laboratory custody will conform to procedures established in ERD PD 5.7, "Chain of Custody Record," and ERD PD 5.5, "Obtaining Laboratory Services." These procedures include:

- Designation of a sample custodian
- Correct completion by the custodian of the COC record and laboratory request sheet, including documentation of sample condition upon receipt
- Laboratory sample tracking and documentation procedures
- Secure sample storage.

The sample will be delivered to the laboratory so requested analyses can be performed within the specified allowable holding time. The sample will be accompanied by the COC with an appropriate sample analysis request. The sample will be delivered to the person in the laboratory who is authorized to receive samples (Laboratory Sample Custodian). Samples will be packaged and shipped according to DOT and EPA regulations.

## 7.10 Final Evidence Files

The WAG Manager or Project Manager is responsible for active project files. At an appropriate time, the WAG or Project Manager will transfer files to ARDC. Final evidence files include all information and documentation developed in the field and laboratory.

Copies of all analytical data and final reports will be retained in the laboratory files and, at the discretion of the Laboratory Manager, data will be stored on computer disk for a minimum of one year.

Additional guidance on establishing administrative record data and data control is contained in the DMP.

# 8. CALIBRATION PROCEDURES AND FREQUENCY

Field Sampling Procedures outline calibration procedures and the calibration frequency for field instruments. Guidance of the EPA CLP SOW for Inorganics (EPA, 1988b or 1990), Test Methods for Evaluating Solid Waste, (EPA, 1986a), and Methods for the Determination of Organic Compounds in Drinking Water (EPA, 1988a) shall be followed in determining laboratory instrument calibration procedures and frequency for chemical analysis. Measuring and testing equipment calibration may be performed internally using standards traceable to the NIST, where applicable, or externally by the equipment manufacturer or approved calibration facility. If no nationally recognized standard exists for the equipment to be calibrated, the basis for calibration shall be documented.

Responsibility for calibrating laboratory equipment rests with the Laboratory Manager for onsite and offsite laboratories. The Field Team Leader is responsible for ensuring that equipment used by the sampling crew in the field is calibrated. Field calibration records will be collected by the Field Team Leader for the final evidence files where lab calibration records will also be maintained. The radiological and industrial hygiene equipment calibration responsibility rests with health physics and industrial hygiene personnel, respectively.

It is the responsibility of personnel using the equipment to check the calibration status prior to using it and to ensure that the equipment is operational prior to taking it to the sampling locations.

Documented and approved procedures shall be used to calibrate all measuring and testing equipment. Whenever possible, widely accepted procedures such as those published by EPA (1986a), or procedures provided by the equipment manufacturer shall be used.

At a minimum, calibration data to be provided from the analytical laboratory is as follows:

- Equipment type used and detection limits of that specific equipment
- Calibration method and sequential actions
- Calibration curve data
- Calibration data recording form and format
- List of primary and secondary standards used
- Continuing calibration control charts
- List of critical or replacement parts.

Each piece of equipment shall be identified so that the pertinent calibration information can be retrieved. The equipment shall have an individual calibration log and be calibrated/standardized prior to use or as part of the operational use following the manufacturer's recommended calibration/standardization procedure(s). The frequency of calibration shall also be based on the requirements of the analytical method.

Measuring and testing equipment shall be calibrated at prescribed intervals or prior to use. Frequency shall be based on the type of equipment, inherent stability, manufacturer's recommendations, intended use, and experience.

Records shall be prepared and maintained for each piece of calibrated equipment to indicate that established calibration procedures have been followed. Calibration records for the equipment controlled by the various laboratories, offices, and groups shall be maintained by the respective organization. A copy of the instrument logbook shall be provided for the period the instrument was used for TAN samples.

Equipment that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use or shall be tagged to indicate it is out of calibration. Such equipment shall be repaired or recalibrated prior to further use.

Data generated during downtime, failure of the instrument, or an instrument that requires adjustment during recalibration shall be evaluated by the Laboratory QA Officer for acceptability. Results of the evaluation shall be documented and retained in the project files.

# 9. ANALYTICAL PROCEDURES

One or more analytical laboratories may be used. The choice of laboratory depends upon the DQOs for the task, the ability of the laboratory to perform a method, the acceptance criteria of a sample's radionuclide content, and the acceptability of the laboratory's QA/QC program. The analytical laboratory shall be approved prior to bid award based on audit results by ERD prior to use. Audit procedures are described in Section 12 of this QAPjP. Analytical methods are listed in Table 5-1.

# 10. DATA REDUCTION, VALIDATION, AND REPORTING

Data reduction and reporting procedures are described in detail in the Data Management Plan, which describes management of field- and laboratory-generated data from point of generation to point of use. The DMP is consistent with EPA Guidance or requirements per specific method and the EG&G Idaho Sample Management Office SOPs for validating data (EG&G Idaho, 1991). EG&G Idaho ERD SMO SOPs for the validation of inorganic and organic data are consistent with the requirements of the EPA functional guidelines for data validation.

The first round of the data from the analysis of groundwater samples collected from the new remedial investigation wells will be validated at Level B as defined in SMO-SOP-12.1.1. The second round of groundwater data will be validated at Level B. The data from the analysis of groundwater samples collected at the existing wells will all be validated at Level B as defined in SMO-SOP-12.1.1.

Because rapid turnaround of data from the mobile laboratory is necessary and will not allow an extensive data quality review, the quality of data generated by the laboratory will be based on a pre-award audit and a review of the subcontractor's analytical capabilities. Additionally, duplicates for 10% of the total number of samples analyzed by the mobile laboratory will be sent to an offsite laboratory for confirmatory analysis. Performance criteria for precision and accuracy will be provided in the statement of work for analytical services for implementation by the Project Manager in the field.

All samples analyzed at offsite laboratories will be validated at level B as defined in SMO-SOP-12.1.1. These samples include the duplicates sent from the mobile laboratory to the offsite laboratory.

Under level B validation, analytical data are reviewed for the following:

- Data package completeness
- Requested versus reported analyses
- Analytical holding times
- Method blank criteria
- Matrix spike/matrix spike duplicate recoveries/precision
- Duplicate sample precision
- Surrogate spike recoveries
- Laboratory control sample recoveries (radiological methods)
- Any other method-specific quality control criteria.

Radiological data validation will be conducted per SMO-SOP-12.1.2.

# 11. INTERNAL QUALITY CONTROL CHECKS

Several types of internal QC checks will be utilized during sampling. These include, but are not limited to the following:

- Decontamination (equipment rinsate) blanks
- Volatile organic analysis (VOA) trip blank--one per cooler shipped
- Field and laboratory duplicates, replicates, or triplicate samples.

Amounts of each of the control samples listed above will be specified in the FSP and EPA protocols. Internal QC check samples will be analyzed along with site samples.

## 11.1 Offsite and Mobile Laboratory QA/QC

The laboratory QA/QC procedures used will be those submitted by the laboratory in its written QA plan. The submitted plan should provide for use of standards, laboratory blanks, duplicates, and spiked samples for calibration and the identification of potential matrix interferences. Laboratory results of matrix spike (MS) and matrix spike duplicate (MSD) sample analyses shall be provided in a manner that will allow assessment of accuracy and precision. Adequate statistical procedures will be used to monitor and document performance and to implement an effective program to resolve testing problems (e.g., instrument maintenance and operator training).

Specific routine procedures used to assess data precision, accuracy, and completeness are described in Section 14 of this QAPjP.

## 11.2 Field QC Samples

Blind QC samples listed below will be either collected in the field or generated in the lab and sent to the field, then shipped to the laboratories with other samples.

- Trip blank--Trip blanks provide a measure of potential sample contamination due to the presence of contaminants in the reagent water source, to preservative contamination of the blank itself during blank preparation, to the shipment of the prepared blank to the field, and to the shipment from the field to the laboratory. The trip blank will be prepared using the lab's reagent water, with the addition of all appropriate preservative chemicals. Trip blanks accompany the sample shipping container and will remain unopened until after the laboratory receives them for analysis.

  Trip blanks will be collected at a minimum frequency of one per sampling episode for VOAs and will be shipped blind to the laboratory(ies) with other samples and analyzed for volatile organics only.

- Decontamination (equipment) blank--A decontamination blank will be prepared and submitted for analysis at a minimum frequency of 1 per every 20 samples for each sample medium. This blank will consist of deionized rinse water collected after the water has rinsed decontaminated equipment and will be analyzed for the same parameters as the sample group it checks.

- Field blank--Field blanks provide a measure of potential errors that can be introduced from sources other than the sample. A field blank will also measure input from contaminated dust or air into the sample. A field blank is prepared in the field by pouring deionized or reagent-grade (analyte-free) water into the appropriate sample containers and includes all appropriate preservative chemicals. Field blanks are prepared at a minimum frequency of 1 per 20 samples for each sample medium.

- Field replicates--Field replicates are collocated samples collected identically and consecutively over a minimum period. Field replicates provide a measure of the total analytical bias (field and laboratory variance), including bias resulting from the heterogeneity of the replicate sample set itself. Field replicates will be collected at a minimum frequency of 1 per 20 samples or 1 per sampling round for each sample medium. Samples collected for VOA will not be homogenized because this increases volatilization.

# 12. SYSTEM AND PERFORMANCE AUDITS

Audits and surveillance are systematic checks to determine whether or not personnel on a project are adhering to the requirements outlined and referenced in the QAPjP and the SAP. Audits of laboratory activities and surveillance of field activities are the responsibility of the ERD Quality Engineer.

The Quality Engineer, in conjunction with the ERD Project Manager, will determine the frequency of quality monitoring for this project. Checklists will be developed to accomplish the review of necessary items and to document results of the audit/surveillance.

Two types of audits will be performed: systems audits and performance audits. Details of these are contained in the following subsections.

## 12.1 Systems Audits

Systems audits consist of evaluating all components of the applicable measurement systems to determine their proper selection and use. At least one systems audit will be performed before or shortly after systems are operational to do the following:

- Verify that the QA organization is operational
- Verify that correct sampling methodologies have been chosen and that written procedures for sampling are available and being followed.

Systems audits of laboratories are qualitative audits of the measurement systems, ensuring they are properly maintained and used. These audits are performed before approval of a contract. A laboratory will be audited, and its QA plan will be reviewed and accepted by the ERD Compliance Assurance Unit prior to being awarded a contract. The laboratory approval process is detailed in ERD Program Directive 5.6, "Conducting Audits of Laboratories."

Technical experts will be assigned to the audit teams for laboratory audits. Audits of laboratories will be announced and planned. All audits will be conducted in accordance with approved project directives and an enhanced checklist modified from the checklist developed by CLP program.

## 12.2 Performance Audits

Laboratory performance audits and field surveillance normally will be conducted after data production systems are operational and generating data.

### Field Operations

Surveillances will be conducted on field activities as field data are generated, reduced, and analyzed. The procedure for conducting field surveillance is detailed in ERD PD 5.14, "Quality Monitoring and Surveillance." Items examined will include, but are not limited to, calibration records of field equipment, daily entries in logbooks, decontamination procedures, photographs, video logs, data logs, drilling, well installation, and sampling. At a minimum, one field surveillance will be performed every other week while field activities are in progress.

After completion of the surveillance, any deficiencies will be discussed with the field staff, and corrections will be identified. If any of these deficiencies could affect the integrity of the samples being collected, the Program Manager will inform the field staff immediately so that corrective action can be implemented immediately. The Program Manager will submit a surveillance report to the Project Manager of the task and to the organization or subcontractor that was surveyed.

The Field Team Leader or the Project Manager will respond to findings listed in the surveillance report, in writing, to the ERD WAG 1 Manager. The response will clearly state the corrective action taken or planned. If corrective actions have not been completed prior to issuance of the audit response, a scheduled date for completion will be provided. Requests for

corrective action must be addressed to the satisfaction of the ERD WAG 1 Manager.

Completion of the corrective action will be verified by the Program Manager through written communication, follow-up surveillance, or other appropriate means. After acceptance and verification of the corrective action, a surveillance closure will be issued to the same individuals receiving the surveillance report.

## 12.3 Reports

Following completion of an audit or surveillance, the Quality Engineer or Lead Auditor will prepare and submit a post-audit/surveillance report.

The report will include the following information, when appropriate:

- Date(s) of the audit/surveillance
- Identification of audit/surveillance participants
- Identification of activities audited/surveyed
- Audit/surveillance results
- Description of items requiring corrective action
- Due date for completion of corrective actions and/or audit/surveillance response
- Means for audit/surveillance response (in writing).

A corrective action plan will then be prepared by the program being audited/surveyed. This will include a list of solutions or corrective actions that were taken to resolve problems identified by the auditors/quality engineers. When appropriate, a schedule for implementing corrective actions will be included in the corrective action report. Copies of the audit/surveillance report and corrective action responses will be sent to the Project Manager and Program Manager by the Quality Engineer.

# 13. PREVENTIVE MAINTENANCE

Measuring and test equipment used in the field and laboratory will be controlled by a calibration program in compliance with "Control of Measuring and Test Equipment" (QP-12) of EG&G Idaho (1990). Equipment of the proper type, range, accuracy, and precision will provide data compatible with project requirements and desired results. Calibration of measuring and test equipment may be performed internally using reference standards, or externally by agencies or manufacturers (see Section 8).

Preventive maintenance for field equipment will be accomplished by preparing a schedule of preventive maintenance, and by preparing a list of critical parts that should be on hand to minimize downtime. Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent use or will be tagged to indicate that it is out of calibration. Such equipment will be repaired and calibrated to the satisfaction of the manager of the laboratory, manager of the task, or manager of the Health Physics Instrument Laboratory, as appropriate, before further use. Equipment that cannot be repaired will be replaced.

Data generated from equipment that has failed calibration shall be evaluated and qualified for use on the project. The evaluation/qualification process is the responsibility of the cognizant manager and the Quality Engineer. The method of qualification and the results of the data evaluation will be documented.

Documented and approved laboratory procedures will be used to calibrate analytical instruments. These procedures will include, as a minimum:

- Type of equipment to be calibrated
- Calibration method and sequential actions
- Calibration data recording form/format
- A list of critical or replacement parts.

The information above will, in general, conform to the manufacturer's recommended procedures or explain the deviation from these procedures.

Laboratory equipment requiring routine maintenance will have an individual instrument file indicating the frequency of required maintenance history, spare parts maintained by the laboratory, directions for maintenance, and any external service contracts.

Analytical laboratory preventive maintenance will be the responsibility of the laboratory. However, at a minimum, the laboratory will be required to have the following:

- Service contracts or major instruments, when necessary
- Spare parts, as recommended by the instrument manufacturer
- The above items delineated in the laboratories' written QA/QC plan.

# 14. DATA ASSESSMENT PROCEDURES

Procedures to assess precision, accuracy, and completeness of data collected from sampling and analysis are different for field and laboratory data. Field and laboratory procedures are described in this section.

## 14.1 FIELD DATA

Field data include all data recorded in field logbooks during field sampling activities. Field precision and accuracy will be assessed by conducting field audits to ensure use of uniform sample collecting, handling, and shipping procedures and by evaluation of field blanks.

### Procedures to Assess Field Data Precision

Field precision will be assessed by field audits and checklists performed on a routine basis. These audits will document use (or nonuse) of uniform sampling methods and handling and shipping procedures. Field sampling precision will be assessed by analytical results of collocated (duplicate), split, or field blank samples, and through use of equipment blanks. These blanks will identify compounds inadvertently introduced onto the samples from contaminated sampling equipment.

### Procedures to Assess Field Data Accuracy

Accurate sample collection will be evaluated from the results of field systems audits that include onsite evaluations of sample collection procedures, instrument performance, and calibration procedures. Field sampling accuracy cannot be assessed quantitatively because the "true" value is not available.

### Procedures to Assess Field Data Completeness

Completeness of field data will be assessed by calculating the ratio of samples analyzed to the total number of samples planned, stated as a percentage.

## 14.2 Laboratory Data

The QAPjP and analytical laboratories methods describe precision, accuracy, and completeness. Accuracy and precision of data will be assessed for each sample lot using percent recovery and relative percent difference of MS/MSD pair analysis.

### Procedures to Assess Laboratory Precision

Precision of laboratory data will be measured by analysis of duplicates. Laboratory reagent blanks will be analyzed to monitor introduction of artifacts into the process. If data obtained are not within the control limits specified in EPA CLP SOW for Inorganics (EPA, 1988b or 1990), in EPA (1988a), and in EPA (1986a), corrective action will be taken.

### Procedures to Assess Laboratory Accuracy

Accuracy of chemical laboratory data will be assessed by examining the percent recovery of the MS/MSD and analytical spikes for organics, and surrogates and internal standards for inorganics. Accuracy of radiological laboratory data will be assessed by measuring the activity of known QC check samples and by demonstrating reasonable agreements (e.g., plus or minus three standard deviations) and demonstrating instances in which the known is traceable to a reputable standard (e.g., National Bureau of Standards).

### Procedures to Assess Laboratory Completeness

Completeness of laboratory data will be measured by the ratio of samples received at the laboratory to the total number of samples analyzed, stated as a percentage.

# 15. CORRECTIVE ACTION PROCEDURES

Corrective action procedures are implemented when samples do not meet QA specifications. In all cases, corrective action procedures will be approved by the Project QA Engineer.

Limits and corrective actions for all analyses will be as specified in the laboratory analytical Statement of Work, as well as in Methods for the Determination of Organic Compounds in Drinking Water (EPA, 1988a) and in the Test Methods for Evaluating Solid Waste (EPA, 1986a). Limits and corrective action for inorganic analyses will be as specified in the EPA CLP SOW (EPA, 1988a or 1990). Other corrective actions may have to be implemented based on performance, system, or evidence audits performed. These will be developed on a case-by-case basis.

Corrective action procedures that might be implemented from audits or detection of unacceptable data are developed on a case-by-case basis. Such actions may include altering procedures in the field, resampling or retesting, using a different batch of containers, or recommending an audit of laboratory procedures. Corrective actions to any major nonconformances associated with field activities will be incorporated in addenda to field sampling plans.

Data will be validated as described in the DMP, which follows EPA procedures. Data that cannot be validated using procedures outlined in the DMP will be reviewed in detail in an attempt to evaluate each measurement.

Contract-required detection limits for parameters analyzed with the CLP SOW for Inorganics (EPA, 1988b or 1990), and method detection limits for organics (524.2 and 8010) (EPA, 1988a; 1986a) are presented in Appendix A.

# 16. QUALITY ASSURANCE REPORTS

A periodic performance report of the QA Program will be prepared by the Project QA Officer and presented to the Project Manager. When appropriate, analytical laboratory QA/QC reports will be included. At task completion, and after data verification and validation, all QC data will be sent to ARDC to become part of the program files.

QA reports will include:

- Results of any systems and performance audits conducted during the period
- Assessment of precision, accuracy, representativeness, completeness, and comparability of data collected during the period
- Nonconformance reports issued during the period, related corrective actions undertaken, and an assessment of action results
- Significant QA problems and recommended solutions
- Summary of personnel training and QA objectives met.

The final report will have a section that summarizes the periodic reports.

# 17. REFERENCES

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12.1.1 - SMO SOP Level of method validation, July 12, 1991
12.1.2 - SMO SOP Radiological data validation, August 1, 1991
12.1.3 - Validation of volatile and semi volatile organic gas chromatographyl mass spectrophotometric data, August 9, 1991
12.1.4 - Validation of gas chromatographic data, August 9, 1991
12.1.5 - Validation of inorganic data validation, to be issued

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EPA, 1980, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, December 29, 1980.

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EPA, 1988b and 1990, "Contract Laboratory Program Statement of Work for Inorganics Analysis Multi-media, Multi-concentrations," SOW-780, Office of Emergency and Remedial Response, July 1988 and 1990.

EPA, 1990, "National Oil and Hazardous Substances Pollution Contingency Plan," Federal Register, Volume 55, No. 46, pp. 8813-8865, 1990.

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# APPENDIX A

- CONTRACT-REQUIRED DETECTION LIMITS FOR INORGANICS,
- METHOD DETECTION LIMITS FOR VOLATILE ORGANICS (524.2),
- METHOD DETECTION LIMITS FOR VOLATILE ORGANICS (SW-846-8010),
- METHOD FOR DETERMINATION OF PRACTICAL QUANTITATION LIMIT
- CONTAMINATANTS OF CONCERN-MCLs, RISK-BASED CONCENTRATIONS AND DETECTION LIMITS

Table A-1. Inorganic CLP SOW contract-required detection limits

| Metal | Water (µg/L) | soils[a] (approximate) (µ/Kg) |
|---|---|---|
| Al | 200 | 40 |
| Sb | 60 | 12 |
| As | 10 | 2 |
| Ba | 200 | 40 |
| Be | 5 | 1 |
| Cd | 5 | 1 |
| Ca | 5000 | 1000 |
| Cr | 10 | 2 |
| $Cr^{+6}$ | 2 | -- |
| Co | 50 | 10 |
| Cu | 25 | 5 |
| Fe | 100 | 20 |
| Pb | 3 | 1 |
| Mg | 5000 | 1000 |
| Mn | 15 | 3 |
| Hg | 0.2 | 0.04 |
| Ni | 2 | 8 |
| K | 5000 | 1000 |
| Se | 5 | 1 |
| Ag | 10 | 2 |
| Na | 5000 | 1000 |
| Ti | 10 | 2 |
| V | 50 | 10 |
| Zn | 20 | 4 |
| Cn | 10 | -- |

a. Based on one gram of soil digested to 200 ml of digestant. Actual detection limits for soils will vary with quantity of soil digested (1 to 1.5 g) and soil moisture content. Based on CLP SOW (EPA, 1988 and 1990).

**Table A-2.** USEPA Method 524.2 (Rev.3.0) target analyte list and method detection limits (MDL)[a]

| Volatiles | CAS Number | Method Detection Limits[b] Wide Bore Column (µg/L) | Narrow Bore Column (µg/L) |
|---|---|---|---|
| 1. Dichlorodifluoromethane | 75-71-8 | 0.10 | 0.11 |
| 2. Chloromethane | 74-87-3 | 0.13 | 0.05 |
| 3. Vinyl Chloride | 75-01-4 | 0.17 | 0.04 |
| 4. Bromomethane | 74-83-9 | 0.11 | 0.06 |
| 5. Chloroethane | 75-00-3 | 0.10 | 0.02 |
| 6. 1,1-Dichloroethene | 75-35-4 | 0.12 | 0.05 |
| 7. Methylene Chloride | 75-04-2 | 0.03 | 0.09 |
| 8. trans-1,2-Dichloroethene | 156-60-5 | 0.06 | 0.03 |
| 9. 1,1-Dichloroethane | 75-34-3 | 0.04 | 0.03 |
| 10. 2,2-Dichloropropane | 590-20-7 | 0.35 | 0.05 |
| 11. cis-1,2-Dichloroethene | 156-69-4 | 0.12 | 0.06 |
| 12. Chloroform | 67-66-3 | 0.03 | 0.02 |
| 13. Bromochloromethane | 74-97-5 | 0.04 | 0.07 |
| 14. 1,1,1-Trichloroethane | 71-55-6 | 0.08 | 0.04 |
| 15. Carbon Tetrachloride | 56-23-5 | 0.21 | 0.08 |
| 16. 1,1-Dichloropropene | 563-58-6 | 0.10 | 0.02 |
| 17. Benzene | 71-43-2 | 0.04 | 0.03 |
| 18. 1,2-Dichloroethane | 107-06-2 | 0.06 | 0.02 |
| 19. Trichloroethene | 79-01-6 | 0.19 | 0.02 |
| 20. 1,2-Dichloropropane | 78-87-58 | 0.04 | 0.02 |
| 21. Bromodichloromethane | 75-27-4 | 0.08 | 0.03 |
| 22. Dibromomethane | 74-95-3 | 0.24 | 0.03 |
| 23. trans-1,3-Dichloropropene | 10061-02-6 | ND | ND |
| 24. Toluene | 108-88-3 | 0.11 | 0.08 |
| 25. cis-1,3-Dichloropropene | 10061-01-5 | ND | ND |
| 26. 1,1,2-Trichloroethane | 79-00-5 | 0.10 | 0.03 |
| 27. Tetrachloroethene | 127-18-4 | 0.14 | 0.05 |
| 28. 2,3-Dichloropropane | 142-28-9 | 0.04 | 0.04 |
| 29. Dibromochloromethane | 124-48-1 | 0.05 | 0.07 |
| 30. 1,2-Dibromoethane | 106-93-4 | 0.06 | 0.02 |
| 31. Chlorobenzene | 108-90-7 | 0.04 | 0.03 |
| 32. 1,1,2,2-Tetrachloroethane | 630-20-6 | 0.05 | 0.04 |
| 33. Ethylbenzene | 100-41-4 | 0.06 | 0.03 |
| 34. Xylene (total meta & para) | 1330-20-7 | 0.13 | 0.06 |
| 35. Xylene (ortho) | 95-47-6 | 0.11 | 0.06 |

**Table A-2.** (continued)

| Volatiles | CAS Number | Method Detection Limits[b] Wide Bore Column (µg/L) | Method Detection Limits[b] Narrow Bore Column (µg/L) |
|---|---|---|---|
| 36. Styrene | 100-42-5 | 0.04 | 0.06 |
| 37. Bromoform | 75-25-2 | 0.12 | 0.20 |
| 38. Isopropylbenzene | 98-82-8 | 0.15 | 0.10 |
| 39. 1,1,2,2-Tetrachloroethane | 79-34-5 | 0.04 | 0.20 |
| 40. Bromobenzene | 108-86-1 | 0.03 | 0.11 |
| 41. 1,2,3-Trichloropropane | 96-18-4 | 0.32 | 0.03 |
| 42. n-Propylbenzene | 103-65-1 | 0.04 | 0.06 |
| 43. 2-Chlorotoluene | 95-49-8 | 0.04 | 0.05 |
| 44. 1,3,5-Trimethylbenzene | 108-67-8 | 0.05 | 0.02 |
| 45. 4-Chlorotoluene | 106-43-4 | 0.06 | 0.05 |
| 46. tert-Butylbenzene | 98-06-6 | 0.14 | 0.33 |
| 47. 1,2,4-Trimethylbenzene | 95-63-6 | 0.13 | 0.04 |
| 48. sec-Butylbenzene | 135-98-8 | 0.13 | 0.12 |
| 49. 1,3-Dichlorobenzene | 543-73-1 | 0.12 | 0.05 |
| 50. 1,4-Dichlorobenzene | 106-46-7 | 0.03 | 0.04 |
| 51. n-Butylbenzene | 104-51-8 | 0.11 | 0.03 |
| 52. 1,2-Dichlorobenzene | 95-50-1 | 0.03 | 0.05 |
| 53. 1,2-Dibromo-3-chloropropane | 96-12-8 | 0.26 | 0.05 |
| 54. 1,2,4-Trichlorobenzene | 120-82-1 | 0.04 | 0.20 |
| 55. Hexachlorobutadiene | 87-68-3 | 0.11 | 0.04 |
| 56. Naphthalene | 91-20-3 | 0.04 | 0.04 |
| 57. 1,2,3-Trichlorobenzene | 87-61-6 | 0.03 | 0.04 |

a. Method detection limits are those published in the method and may not be achievable in all laboratories (see the Introduction to this section).

b. Method 524.2 is applicable to water samples only. The Method Detection Limits are listed for wide bore and narrow bore capillary columns. A wide bore capillary column is defined as having an internal diameter of greater than 0.32 mm. The data for the narrow bore column was obtained using the cryogenic trapping option in the method.

ND = Not Determined for this compound. Use the laboratory determined MDL for reporting.

**Table A-3.** Target analyte list and method detection limits for halogenated volatile organics - SW-846-8010

| Compound | Retention time (min) Col. 1 | Retention time (min) Col. 2 | Method detection limit[a] (ug/L) |
|---|---|---|---|
| Benzyl chloride | | | |
| Bis(2-chloroethoxy)methane | | | |
| Bis(2-chloroisopropyl)ether | | | |
| Bromobenzene | | | |
| Bromodichloromethane | 13.7 | 14.6 | 0.10 |
| Bromoform | 19.2 | 19.2 | 0.20 |
| Bromomethane | | | |
| Carbon tetrachloride | 13.0 | 14.4 | 0.12 |
| Chloroacetaldehyde | | | |
| Chlorobenzene | 24.2 | 18.8 | 0.25 |
| Chloroethane | 3.33 | 8.68 | 0.52 |
| Chloroform | 10.7 | 12.1 | 0.05 |
| 1-Chlorohexane | | | |
| 2-Chloroethyl vinyl ether | 18.0 | | 0.13 |
| Chloromethane | 1.50 | 5.28 | 0.08 |
| Chloromethylmethyl ether | | | |
| Chlorotoluene | | | |
| Dibromochloromethane | 16.5 | 16.6 | 0.09 |
| Dibromomethane | | | |
| 1,2-Dichlorobenzene | 34.9 | 23.5 | 0.15 |
| 1,3-Dichlorobenzene | 34.0 | 22.4 | 0.32 |
| 1,4-Dichlorobenzene | 35.4 | 22.3 | 0.24 |
| Dichlorodifluoromethane | | | |
| 1,1-Dichloroethane | 9.30 | 12.6 | 0.07 |
| 1,2-Dichloroethane | 11.4 | 15.4 | 0.03 |
| 1,1-Dichloroethylene | 8.0 | 7.72 | 0.13 |
| trans-1,2-Dichloroethylene | 10.1 | 9.38 | 0.10 |
| Dichloromethane | | | |
| 1,2-Dichloropropane | 14.9 | 16.6 | 0.04 |
| trans-1,3-Dichloropropylene | 15.2 | 16.6 | 0.34 |
| 1,1,2,2-Tetrachloroethane | 21.6 | | 0.03 |
| 1,1,1,2-Tetrachloroethane | | | |
| Tetrachloroethylene | 21.7 | 15.0 | 0.03 |
| 1,1,1-Trichloroethane | 12.6 | 13.1 | 0.03 |
| 1,1,2-Trichloroethane | 16.5 | 18.1 | 0.02 |
| Trichloroethylene | 15.8 | 13.1 | 0.12 |
| Trichlorofluoromethane | 7.18 | | |
| Trichloropropane | | | |
| Vinyl chloride | 2.67 | 5.28 | 0.18 |

[a] Using purge-and-trap method (Method 5030).

**Table A-4.** Determination of practical quantitation limits (PQL) for various matrices[a]

| Matrix | Factor[b] |
|---|---|
| Groundwater | 10 |
| Low-level soil | 10 |
| Water miscible liquid waste | 500 |
| High-level soil and sludge | 1250 |
| Non-water miscible waste | 1250 |

a. Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable.

b. PQL = Method detection limit (Table A-1) X Factor (Table A-2). For nonaqueous samples, the factor is on a wet-weight basis.

**Table A-5.** Preliminary contaminants and their respective MCLs, risk-based concentrations, and detection limits[a]

| Chemical | MCL (ug/L) | Risk at MCL | Risk-based concentrations: Risk=10-6 (ug/L) | Risk-based concentrations: Risk=10-4 (ug/l) | Risk-based concentrations: HI=1 (ug/L) | Detection limits (ug/L) |
|---|---|---|---|---|---|---|
| 1,1 Dichloroethylene | 7 | 1.0E-4 | 0.07 | 7 | 300 | 0.50 |
| Tricloroethylene | 5 | 2.0E-6 | 3 | 300 | NA | 0.50 |
| Tetrachloroethylene | 5 | 3.0E-6 | 1 | 100 | 400 | 0.50 |
| Lead | 5 | NA | NA | NA | NA | 3.0[b] |
| Mercury | 2 | NA | NA | NA | 10 | 0.20[b] |
| Radionuclides[c] | MCL (pCi/L) | | (pCi/L) | (pCi/L) | | Quantitation Limits (pCi/L) |
| Stontium-90 | 8 | 1.0E-5 | 0.60 | 60 | NA | 1.0 |
| Tritium | 20,000 | 1.0E-4 | 357 | 35,700 | NA | 500 |

a. The data that support this list of contaminants are contained in the appendices of the RI/FS Work Plan. The contaminants were identified from validated data from 1989 and 1990 ground water sampling and include only those contaminants that were found in both years. Contaminants found in only one year at low levels (<15 ppb) or in the unvalidated 1990 sludge data were not included in this list because they were not considered to be significant problems. These contaminants included methylene chloride, acetone, toluene, 2-butanone, chloroform, 1,2-dichloroethane, carbon tetrachloride, vinyl chloride, chlorides, sulfates, aluminum, barium, chromium, copper, iron, manganese, nickel, and zinc.

b. Value given is Quantitation limit.

c. These radionuclides have been found in the groundwater and/or the sludge. Three other radionuclides found in the sludge were not included in this list because they were not found in the groundwater (americium-241, eropium-154, and plutonium-239). Two radionuclides, cesium-137 and cobalt-60 were found in the groundwater but at very low levels and were found to be in the safe risk range.